ON THE STRUCTURE AND POPULATION OF THE NEST OF THE COMMON INDIAN TREE ANT, *CREMATOGASTER DOHRNI ROGENHOFERI* MAYR (HYMENOPTERA, FORMICIDAE)

BY

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(With one table, one text-figure and three plates)

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I. INTRODUCTION

(a) General

Although a description of the nest of the common Indian tree ant, *Crematogaster dohrni rogenhoferi* Mayr (Family Formicidae, Subfamily Myrmecinae, Tribe Crematogasterini) has been touched upon by several authors, e.g., Mayr (1878), Wroughton (1892 *a*, *b*) Rothney (1895), Watt (1898), Barlow (1900) and Lefroy (1909), they have merely described and figured the outer structure, and the few details available regarding the inner structure and the composition of the nest-material are either inadequate or faulty. No information is available regarding the nest-population. In the present account I have given a detailed and illustrated description of the outer and inner structure of the nest, the microscopic composition of its material and, finally, the composition of the nest-population. The account is largely based on a nest collected by me recently (17th May 1953). It was built 15 ft. above ground-level on the branches of a mango tree, *Magnifera indica* Linn., at New Forest, Dehra Dun (western Himalayas, *ca.* 2,000 ft. above sea-level). In addition, the following 5 nests are briefly described:— (i) Three small, young nests of *C. d. rogenhoferi* recently (January, 1954) collected by me from the forest on Kankramari *char* (island) in the Sundarbans, Lower Bengal. (ii) Two nests of *Crematogaster* sp. from South India.

(*b*) REVIEW OF *Crematogaster* NESTS

Information regarding the nests of the Indian species of the genus *Crematogaster* is both scanty and widely scattered. Here I have brought together and reviewed the available information.

It has long been known that ants of the genus *Crematogaster* construct large, globular or ovoid nests of papery material either high up on branches of trees or near ground-level. Sykes (1836, p. 101, pl. xiii, fig. 1) described and figured the nests of *Crematogaster physothorax* Emery[1], from the Maharashtra area in peninsular India, which are made among tree branches. According to him, 'they consisted of a multitude of thin folia of *cow-dung* imbricated like tiles upon a house, the folium above all covering the summit in an unbroken sheet, like a skull cap on a man's head'. In one case he also found a queen in the nest. According to Wheeler (1926, p. 215), Kirby (1837) also described the nest of *C. physothorax* Emery[1], and Mayr (1878) of *C. dohrni rogenhoferi* Mayr. Rothney (1895, pp. 205-206) mentioned having found a 'big brown-paper nest' of *C. dohrni rogenhoferi* Mayr at 'Bandora' near Bombay, but did not describe it. Wroughton (1892 *a*, p. 23) observed as follows: '*C. Rogenhoferi* and *C. ebeninus*, and perhaps some other species, (which) build nests of a material which looks like cow-dung, but which is, probably, a sort of coarse brown paper, manufactured from vegetable tissues, and suspend them from the branches of trees, like wasps' nests. The normal situation for the nest of a species is, however, not always strictly adhered to.' He further (1892 *b*, p. 197) remarked that *C.* [*dohrni*] *rogenhoferi* 'builds large nests of 'brown paper', with projecting pen-houses, more or less overlapping one another. The nests may usually thus be distinguished from those of *C. ebeninus*, which, at most, have only rudimentary verandahs. I believe this system of 'frills' is intended to give protection from the sun as much as from the rain; . . . '. Wroughton added that, according to the observations of Aitken, a woodpecker habitually rears its young in the nest of this ant. Barlow (1900, p. 185, pl. xv, fig. 1 *b*) gave a drawing of the nest of *C.* [*dohrni*] *rogenhoferi* Mayr. According to the same author, Watt (1898) made some observations on this species (wrongly identified by Watt as *Crematogaster contenta* Mayr) and found it as infesting tea bushes in Assam. Lefroy (1909, p. 228) gave a figure of the nest of the same species, as copied from Barlow (1900, *vide supra*).

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[1] Synonym: *Myrmica kirbii* Sykes 1836.

Hingston (1925) figured a nest of *C. auberti* from Baghdad, Iraq, which measured only about 4 cm. in diameter and was composed of seeds. Mukerji (1930, p. 153 and pl.) briefly described and figured a nest of *C. soror* Forel from Calcutta; according to him, the nest was composed of vegetable fibres, clay and debris. He added that Prof. Hans Molisch of Vienna, who had examined a piece from this nest, opined that it was composed chiefly of a fungus—a position which is very unsual in *Crematogaster*. Ayyar (1937) gave a detailed description of the nests of *C. dohrni artifex* Mayr from South India, and also briefly touched upon their chemical composition. The nests are globular or ellipsoidal and vary in size from a diameter of *ca.* 3 × 4 inches to about $9\frac{1}{4} \times 11\frac{1}{2}$ and 7 × 12 inches. He further remarked that the eggs and young larvae were found more towards the interior of the nest, and the pupae, the 'teneral adults' and the winged males more towards the periphery; the queens and the workers throng the interior of the entire nest. No special chambers are set apart for the queens. Beeson (1941, pp. 501-502) made a brief mention of the nest of *C. dohrni artifex* from the work of Ayyar (1937, *supra*).

To sum up, the papery nests of the genus *Crematogaster* in India and the neighbouring countries have been mentioned and briefly described by the following authorities, the only detailed description being that of Ayyar (1937) regarding the nest of *C. dohrni artifex* Mayr:—

C. auberti Emery.—BAGHDAD, IRAQ: Hingston, 1925.

C. dohrni artifex Mayr.—INDIA: Ayyar, 1937; Beeson, 1941.

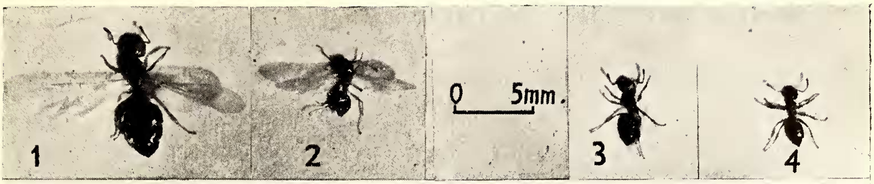
C. dohrni rogenhoferi Mayr.—INDIA: Mayr, 1878; Wroughton, 1892 *a*, *b*; Rothney, 1895; Watt, 1898; Barlow, 1900; Lefroy, 1909; Roonwal, present account.

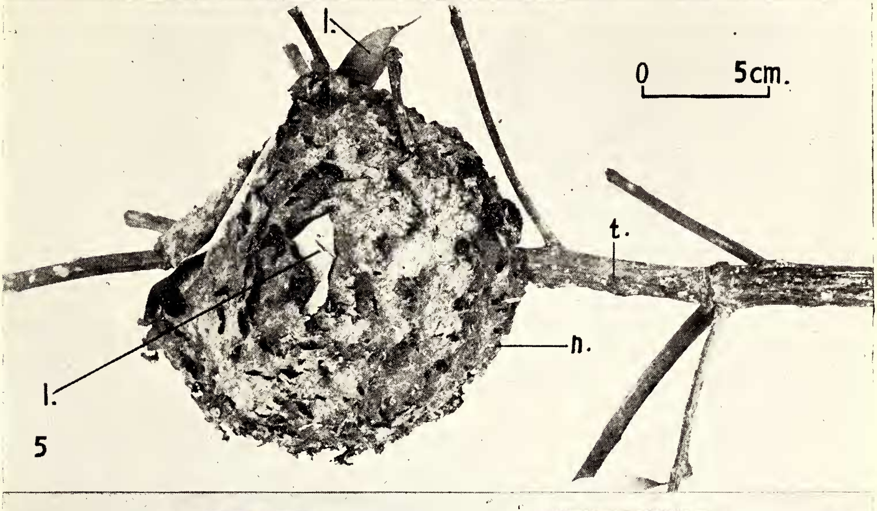
C. physothorax Emery (synonym: *Myrmica kirbii* Skyes).—INDIA: Sykes, 1836; Kirby, 1837.

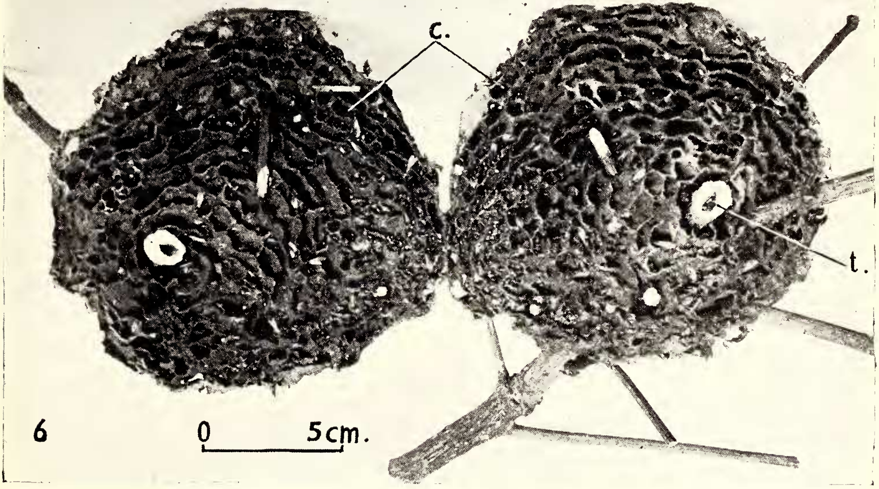
C. soror Forel.—INDIA: Mukerji, 1930.

Crematogaster sp.—INDIA: Roonwal, present account.

According to Ayyar (1937, pp. 296-297), *Crematogaster rothneyi* in South India does not build papery nests on trees but always nests in soil or in crevices in walls.







Photographs of *Crematogaster dohrni rogenhoferi* Mayr collected in New Forest, Dehra Dun (U.P., India) *ca.* 2,000 ft. above sea-level; 17th May 1953, M. L. Roonwal Coll. The individuals in figs. 1-4 are from the single nest shown in figs. 5 and 6.

1—Large winged form. 2—Small winged form. 3—Worker major. 4—Worker minor.

FIG. 5.—Whole nest as seen from outside. Built at a height of about 15 ft. above ground on a mango tree (*Mangifera indica* Linn.).

FIG. 6.—Same, cut into two halves to show the inside structure. The small white dots inside the cells represent the winged ants.

c—cells of the ant nest; *l*—dried up leaves of mango tree; *n*—nest; *t*—twigs.

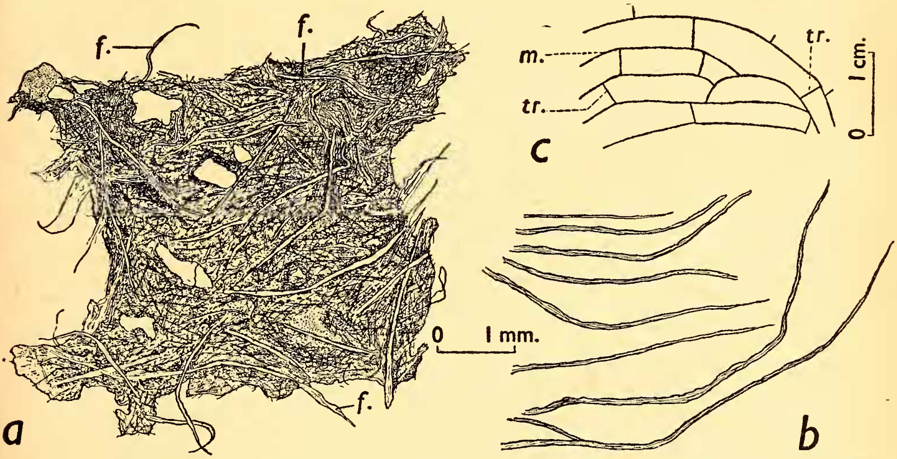
II. NEST-STRUCTURE AND NEST-POPULATION OF *Crematogaster dohrni rogenhoferi* Mayr

(*a*) NEST-STRUCTURE

(*Plate* I *and Text-figure*)

The Dehra Dun nest is a light, globular, dark brown structure, measuring about 13 cm. in diameter. It is composed of papery material giving the appearance of loose felt or dried cow-dung. Examination under the microscope shows that this material is composed of pieces of vegetable matter, e.g., grass leaves, bits of bark, etc., cemented together by some sticky secretion and moulded into light, papery stuff (text-fig. 1 *a*, *b*). The individual vegetable fibres are about 2-6 mm. long and are extremely thin. The nest weighs about 81 gms.

When the nest is carefully cut across[1] it is seen to be composed internally of a large number of interconnected cells which run more or less concentrically, the depth of the cells, i.e., the distance beween the neighbouring walls, being about 3-7 mm., and the width about 8-30 mm. or more. The cell-walls are about 0.5 mm. or less in thickness. The cells are strengthened by means of perpendicular or transverse walls (text-fig. *c*) of similar thickness and similar material. Towards the periphery of the nest the cells are narrower than in the centre. The nest is built around the tree branches in such



TEXT FIGURE (*a*-*c*)—Portion of a nest of *Crematogaster dohrni rogenhoferi* Mayr. (*a*) Portion of the outer covering of nest. Note that the nest is composed of vegetable fibres, bits of bark, etc. cemented together into a papery material. (*b*) A few of the longer vegetable fibres from the nest-wall. (*c*) A few nest-cells near the periphery of the nest.

f—vegetable fibres (bits of grass leaves, etc.); *m*—main cell-walls of nest; *tr*—transverse or perpendicular cell-walls of nest.

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[1] To avoid damage to the delicate, papery nest, the cutting is best done with a small, finely-toothed saw; a bread-knife is excellent for the purpose.

a way that several branches pass right across the nest. In the present case (pl. 1), besides the main twig which is about 1.5 cm. in diameter, 7 other thinner twigs pierce through the nest. Externally, the nest is covered over by a continuous covering of thin, papery laminae of the same material as the remainder of the nest and in such a manner that the nest-cells do not open on the outside except by tiny crevices here and there through which the ants enter and come out of the nest. These crevices are probably partly 'original structures', i.e. are laid down as such while the nest is being constructed and partly 'accidental', i.e., arise by the removal of the external covering here and there by mechanical injury caused by wind, contact with twigs and by other agencies.

(*b*) NEST-POPULATION

The nest-population in the Dehra Dun nest was counted by sampling. When the nest was kept aside after collection, very few individuals came out of it during the first few hours. The nest was then lightly dusted with 5 per cent D.D.T. powder and kept aside. Within an hour or two a large number of individuals—winged forms as well as workers—started crawling out of the nest and, by coming in contact with D.D.T., they died in the next few hours. In this way, individuals continued coming out for four days, after which there were no further emergences. All these individuals were collected. When the nest was cut into two halves after a week, a small number of dead individuals were still found in the nest cells, and were collected. The entire lot of individuals collected from the nest were stirred vigorously in spirit and a sample taken out with a small glass vial. These samples were transferred to another small glass vial of about 1 cm. height and 1.5 cm. inside diameter. The second vial was repeatedly tapped against a soft surface to make the ants settle down in a more or less tight uniform mass. When the tube was thus full to the brim, it was emptied in a glass dish and the contents counted and classified into castes, etc. The volume of the entire collection, in terms of the standard second tube, was then determined and the total number of individuals calculated. To this total a 5 per cent addition was made to account for the individuals still remaining in the nest. In this way the approximate grand total was obtained (Table).

The population consisted of 4 kinds of adults and the pupae, the former being characterised as follows:—

(i) Large winged adults—Body-length *ca.* 8 mm. Body golden brown; abdomen smoky.

(ii) Small winged adults—Body-length *ca.* 3.5 mm. Body golden brown; abdomen smoky.

(iii) Workers major—Body-length *ca.* 5.5 mm. Body golden brown; abdomen large and only faintly smoky, with a whitish band at the posterior margins of the terga.

(iv) Workers minor—Body-length *ca.* 4.5 mm. Body brown, darker than in worker major; abdomen small and darkly smoky (almost blackish to the naked eye), with no white bands at the posterior margins of the terga.

TABLE

Population of a nest of the tree ant, *Crematogaster dohrni rogenhoferi* Mayr, collected at New Forest. Dehra Dun, on 17th May 1953.

Stage and caste		Calculated total (from number actually counted)	Add 5 per cent for individuals left in nest	Total	Percentage of each caste among adults
1. Large winged adults	...	452	23	475	8 %
2. Small winged adults	...	110	6	116	2 %
3. Workers major ...	...	452	23	475	8 %
4. Workers minor...	...	4,676	234	4,910	82 %
Total (adults)	...	5,690	286	5,976	...
5. Pupae ...	..	14	3	17	...
Grand Total	...	5,704	289	5,993	...

The pupae were large and whitish and measured about 5-6 mm. in length.

The total calculated number of individuals (including the few pupae) in the nest, 13 cm. in diameter, was about 5,993 or say 6,000, the composition of the adult population being as follows:—

1. Large winged adults	...	475 individuals	(or 8% of total adults)
2. Small winged adults	..	116 ,,	(or 2% of total adults)
3. Workers major	...	475 ,,	(or 8% of total adults)
4. Workers minor	...	4,910 ,,	(or 82% of total adults)

Ayyar (1937, pp. 303-304 and 307-308) noted that in *Crematogaster dohrni artifex* Mayr in South India in swarming individuals the proportion of females never exceeded 3 per cent of the emerged sexual forms. He further gave the population of a nest, of about $5\frac{1}{2} \times 7\frac{1}{2}$ inches diameter, as follows:—

Caste, etc.		*Number and percentage of individuals*	
1. Workers major, including callows.		39,082 (68·6% of adults)	
2. Workers minor, including callows.		13.192 (23·2% of adults)	
3. Males, winged	...	4,614 (8·1% of adults)	8·2%
4. Females, winged	...	58 (0·1% of adults)	
(a) Total adults :		56,947	
5. Female pupae	...	816	
6. Female larvae, large size	...	634	
7. Smallest larvae, probably workers and males		2,744	
8. Pupae of workers and males	...	1,100	
(b) Total larvae and pupae		5,294	
9. Eggs ...	...	37	
(c) Grand Total		62,278	

The method adopted by Ayyar for counting the nest-population was by sample-weighments of lots. He, however, does not mention whether the samples were dried suitably or not before weighing. Unless uniform drying is done for all the samples, the degree of error in comparing the different samples is likely to be considerable. Assuming that Ayyar's figures provide a correct picture of the proportions of the various castes, a comparison with the proportions observed by me in *C. dohrni rogenhoferi* is of interest. The percentage of the winged adults is nearly the same in both the subspecies—10 per cent winged adults in *C. d. rogenhoferi* and 8.2 per cent in *C. d. artifex.* The percentage of the workers is also similar—90 per cent in *rogenhoferi* and 91.8 per cent in *artifex.* The relative proportion of the major and minor workers, however, differs radically and the tendencies in the two subspecies are, in fact, quite opposite, there being far more workers major (68.6 per cent of total adults) in *artifex* than in *rogenhoferi* (8 per cent of total adults). Correspondingly, the workers minor constitute only 23.2 per cent of total adults in *artifex*, as against 82 per cent in *rogenhoferi.* Among the workers themselves, the proportion of workers major to workers minor in *artifex* is 74.8 per cent and 25.2 per cent respectively or roughly as 3:1; in *rogenhoferi*, 8.1 per cent and 91.9 per cent respectively or roughly as 1:11. Another point of comparison is the density of population in the two nests. In the globular nest of *C. d. rogenhoferi*, with the nest-diameter of 13 cm. (the nest-volume, therefore, being *ca.* 1,151 cu. cm.) the population, including the 17 pupae, was 5,993 individuals, or about 5.2 individuals per cubic centimetre. In the oval nest of *C. d. artifex*, with the nest-diameters of $5\frac{1}{2} \times 7\frac{1}{2}$ inches or about 14 × 19 cm. (mean 10.5 cm.), the nest-volume worked out at about 2,630 cu. cm.; with a total population of 62,278, including larvae and pupae but excluding the 37 eggs, this gave a density of about 26.4 individuals per cubic centimetre, or nearly 5 times as great as in *rogenhoferi.*

(c) THREE NESTS FROM THE SUNDARBANS, LOWER BENGAL

(Plate II)

During a recent survey (January 1954) of the Sundarbans in Lower Bengal, I found small, young live nests of *C. d. rogenhoferi* common on the island named Kankramari *char*[1] which lies in the Muriganga River about 3 miles from Namkhana town. The ecological conditions obtaining on this island are of interest and may be briefly touched upon. The island, which is formed by silting, is of comparatively recent origin (about 60 years or so old) and is growing fast. It is about 8 miles long and about a quarter mile wide. The soil consists of clayey loam over stiff black clay and there is no rock. The altitude is about 15 ft. below the mean sea-level and the island is, therefore,

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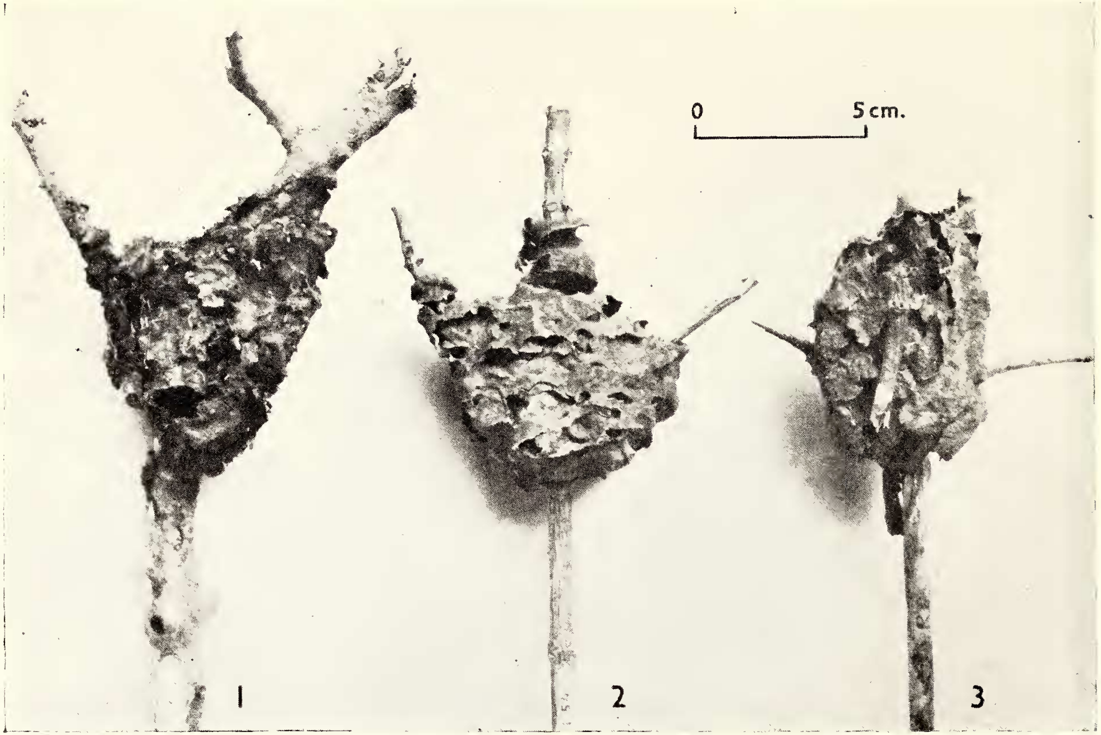
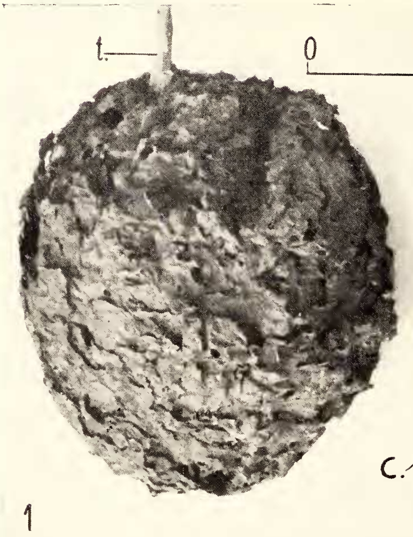
[1] *Char*, in the local dialect, means an island formed by silting.



Photographs of young nest of *Crematogaster dohrni rogenhoferi* Mayr, from the Kankramari *char* (Island), Muriganga R., the Sunderbans, Lower Bengal. M. L. Roonwal Coll., 2nd January, 1954.
1—Field Coll. No. R4/2-1-1954. 2—Field Coll. No. R5/2-1-1954. 3—Field Coll. No. R6/2-1-1954.



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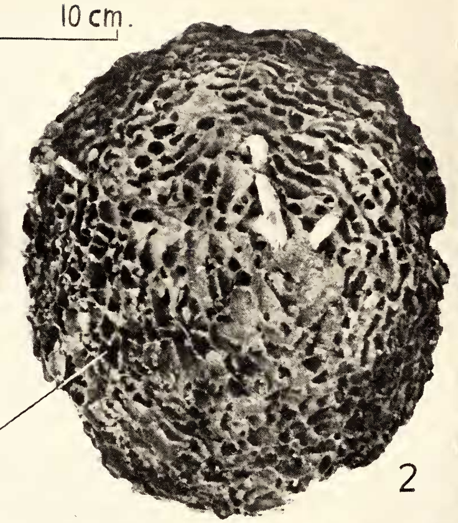

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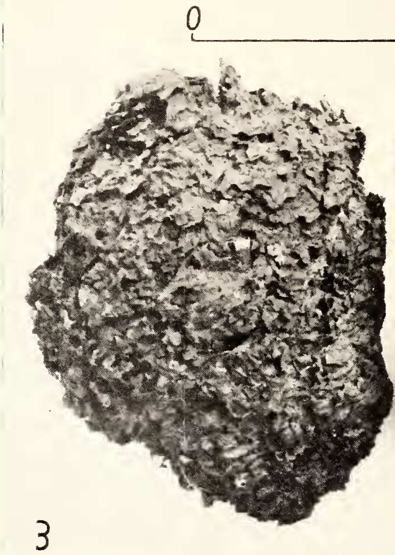

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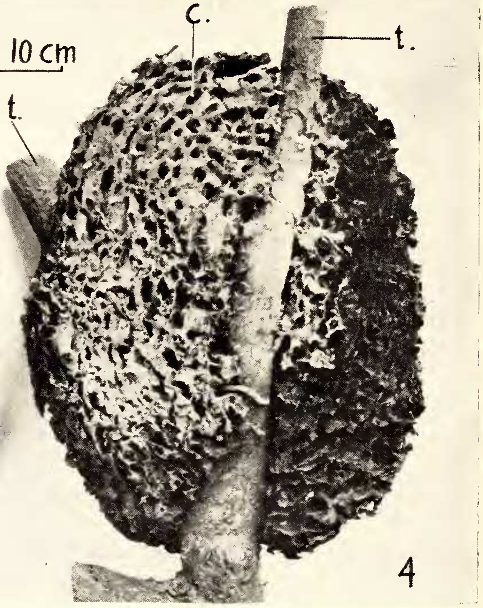

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Photographs of nest of *Crematogaster* sp.

FIG. 1—Nest No. 1 (Ent. Mus. Reg. No. 1001A), as seen from outside. *Crematogaster* sp. North Salem Forest Division, Madras State, India. February 1930, C. F. C. Beeson Coll. Natural size: 17×20 cm. diameter.

FIG. 2—Nest No. 1 (Ent. Mus. Reg. No. 1001A), as seen in longitudinal-vertical section.

FIG. 3—Nest No. 2 (Ent. Mus. Reg. No. 1001B), as seen from outside. *Crematogaster* sp. Same collection data as in nest No. 1 above. Natural size: 13×17 cm. diameter.

FIG. 4—Nest No. 2 (Ent. Mus. Reg. No. 1001B), as seen in longitudinal-vertical section.